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OXIDE SUPERCONDUCTORS UNDER MAGNETIC FIELD

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One of the current most serious problems for the oxide superconductors from the standpoint of practical application is the various novel features derived mainly from their extremely short coherence. In particular, the coherence length so far observed in the cuprate superconductors is in the range of 0.1 nm perpendicular to the CuO_2 plane. This seems to be creating most of the difficulties in the device fabrication and in the performance under the magnetic field.

In this report, some of the superconducting properties under the magnetic field will be discussed in terms of the short coherence length. First of all, it is pointed out that the widely accepted criterion on the Meissner fraction to represent the quality of the specimen is baseless unless very special precautions are taken. The Meissner fraction has been systematically measured under various intensities of the magnetic field and for various morphologies of the samples, including powder, poly- and single-crystals of different superconducting oxides. It is strongly dependent on the field intensity and the size of the specimen. A model will be presented based on the gradual strengthening of the pinning force with decrease in temperature and the weak coupling at the grain boundaries.

Secondly, the broadening of the superconducting transition under the magnetic field is discussed. This is observed significantly only when the field is applied perpendicular to the basal plane and the relative orientation of the current to the field is insignificant in determining the extent of the broadening. Besides, the change in the strength of the pinning force does not affect the width of the broadening. From these observations discussions will be made on a model based on the "giant fluctuation". Based on this model, it is predicted that the coherence length along the c-axis will be the single most important material parameter to determine the performance of the superconductor under a strong magnetic field. It seems that BYCO is superior in this regard to Bi- or Tl-systems as far as the performance at 77K is considered, although another material with the coherence length slightly longer along the c-axis is still highly desired.